



# Construction Execution Plan

Northwest Cap Slope Enhancement  
San Jacinto River Waste Pits Site  
Harris County, Texas

International Paper Company and  
McGinnes Industrial Maintenance  
Corporation





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## 1. Introduction

GHD Services Inc. (GHD), at the request of the International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC; collectively referred to as the Respondents), has prepared this *Construction Execution Plan*, outlining the scope of work to be completed at the San Jacinto River Waste Pits Site, located in Harris County, Texas (Site). The work described herein will be completed to provide enhancement of the slope of the northwest cap of the Northern Impoundment at the Site, in connection with the Administrative Order on Consent (AOC) with the US Environmental Protection Agency (EPA) - Docket No. 06-12-10, May 2010.

## 2. Pre-Construction Activities

The slope enhancement work will consist of the installation of 4,100 square yards of Articulated Concrete Block Mat (ACBM) over the existing cap on the Northern Impoundment. GHD has included shop drawings for the ACBM panels in Appendix A. Reference Appendix B for the ACBM panel specifications. These panels will cover the area identified by Anchor QEA (Anchor) in the "Northwest Cap Enhancement Area" .dwg file transmitted to GHD on December 20, 2018. Following the approval of this Construction Execution Plan, Construction Techniques Inc. (CTI) will fabricate the ACBM panels to the dimensions and specifications contained in Appendix A.

GHD and SRM Concrete, the concrete grout supplier, will mix a test batch of concrete grout. After 28 days, GHD will test the concrete cylinders in order confirm that the preferred mix meets a minimum compressive strength of 2,500 pounds per square inch (psi). GHD's targeted mix design consists of:

- a. Portland Cement - 635 pounds (lbs).
- b. Fly Ash - 260 lbs.
- c. Sand - 2181 lbs.
- d. Water - 519 lbs (62.25 gallons [gals].)
- e. GHD uses an assumed air content of 2 percent.
- f. GHD does not plan to use plasticizers or fiber mesh because grouts that contain these additives typically do not flow well in fabric forms. GHD and CTI have determined that a workable (flowable) mix in fabric forms should have a cement-sand ratio (c/s ratio) between 1:2.75 and 1:2.80.

GHD will contact the USCG to issue a Notice to Mariners for the upcoming work.

Prior to mobilization, GHD will ensure that all project personnel have received OSHA 40-Hour HAZWOPER Training. GHD will also perform a Project Kickoff Meeting with all crew members, subcontractors, and key stakeholders.



### **3. Mobilization and Site Preparation**

GHD will mobilize all crews, equipment, and subcontractors to the Site following the completion of the pre-construction activities.

Project resources will include:

- a. CAT 329 Long Reach Excavator
- b. A Barge-Mounted CAT 320 Long Reach Excavator Provided by Shallow Water Equipment
- c. Two 4-Foot Deep by 24-Foot Wide by 48-Foot Long Adjoining Spud Barges Provided by Shallow Water Equipment
- d. A Crew Boat for Barge and ACBM Panel Transport
- e. A 17-Foot Aluminum Boat with 35 Horsepower GatorTail Motor
- f. CAT 938 Front End Loader with 6-Foot Forks
- g. CAT 1255 Telescopic Forklift
- h. A Four-Man Dive Crew Provided by Underwater Technology Services, Inc.
- i. GHD Site Superintendent
- j. GHD Project Engineer
- k. GHD Health and Safety Officer

As shown on Figure 1, GHD will prepare Site access roads, a concrete pumping pad, and an ACBM panel preparation area using up to 121 8-foot by 14-foot standard laminated board mats from Bridgwell Resources, Inc.

GHD and our licensed surveying subcontractor, Morrison Surveying, Inc. (Morrison Surveying), will stake out the termination points for the ACBM panels and establish survey benchmarks on-Site. The termination points are based on the "Northwest Cap Enhancement Area" .dwg file provided GHD by Anchor on December 20, 2018.

GHD's ACBM panel installer, Community Construction, Inc. (CCI), will set up a remote-operated grout pump, hoses, and pipe floats in the area adjacent to the slope enhancements.

Prior to the installation of any ACBM panels, GHD will install turbidity curtain, oil boom, and sorbent boom in the water surrounding the slope enhancement area.

### **4. Placement of Geotextile Layer on Articulated Concrete Block Mat Panels**

The installation of the 12-ounce nonwoven geotextile is integral to the installation of the ACBM panels. GHD and CCI will prepare each ACBM panels by sewing the geotextile and sand bags to the underside of the panel. Because the geotextile is attached to each panel before the panel is



deployed and grouted, the placement of the geotextile is incidental to the installation of the ACBM panels.

## **5. Installation of Articulated Concrete Block Mat Cap Protection System**

As noted in the previous section, GHD and CCI will cut the 12-ounce nonwoven geotextile to the appropriate lengths and sew the geotextile to each ACBM panel prior to deployment. Sand bags will also be sewn to each panel in order to sink and anchor the panels during deployment. After the geotextile and sand bags have been attached to each ACBM panel, GHD and CCI will attach a spreader bar and marine ropes to the panel and then tightly roll it for transport to the slope enhancement area. GHD will use a loader or forklift to transport the prepared ACBM panels to the slope enhancement area.

The GHD Project Engineer will stake out the termination points for ACBM panels using Trimble global positioning system (GPS) survey equipment. As shown in Appendix A, each ACBM panel will have an identification number that corresponds to the shop drawings. GHD and CCI will install each panel to the established horizontal and vertical limits for the protective cap. Reference Figures 2 to 4 to view the vertical and horizontal extents for the protective cap and the associated lengths of the ACBM panels.

GHD will use the long reach excavators, one land based unit and the other barge mounted, to unroll the panels and stretch them to the specified termination points.

As the panels are being unrolled and stretched into position, the dive team will connect panels using heavy-duty marine zippers and supplementary stainless steel wire ties.

Approximately four (4) 20-foot wide panels will be deployed and connected before the panels are grouted in place. At least one panel will be left unfilled at all times until the end of the project. This is meant to provide connection points (i.e., slack) for newly deployed panels. In areas where the panels cannot be connected by zippers due to the geometry of cap (i.e., curves), GHD will install the panels with a minimum seam overlap of 5-feet. Reference Figure 5 to view the overlap areas.

GHD and CCI will utilize a remote-operated grout pump to fill the ACBM panels with concrete grout. GHD and CCI will establish a dedicated pump area south of the slope enhancement area. One grout pump will be utilized for this project with a backup pump readily available. High density polyethylene (HDPE) will run from the pump to the edge of the slope enhancement area, where a flange connection will transition the HDPE piping to flex hose piping. The flex hose will be used to pump the grout into the ACBM panels. Pipe floats will be attached to the hose, as needed to float it into position. Excavators will be used as needed to position the flexible hose. Panels will be grouted in sections, with a land-based crew grouting the areas above the waterline and the dive team grouting the sections below the waterline. The dive team will use radios built into their dive masks to actively communicate with the land-based dive foreman.

One cubic yard of concrete will fill approximately 50 square feet of fabric. The panel dimensions and the corresponding grout volumes are shown in Appendix A and Table 1. Using these controls, GHD



and CCI will closely monitor the area being covered and the volume of concrete being consumed. The divers will also gauge the thickness of the panels.

## **6. Quality Control Procedures for ACBM Installation**

The following sections detail GHD's quality control measures and describes quality procedures, areas of application, and roles, responsibilities and authorities.

### ***Project Roles and Responsibilities***

1. Contractor  
The Contractor is responsible for implementing the slope enhancement activities described in the Construction Execution Plan. GHD is the Contractor. GHD will staff the project with the following key personnel:
2. Contractor On-Site Superintendent  
The on-Site Superintendent (Superintendent) will be responsible for day-to-day supervision of all construction activities.
3. Contractor Health and Safety Officer  
The Health and Safety Officer will be responsible for implementing the Project HASP and ensuring that all project personnel comply with the applicable Occupational Safety and Health Administration (OSHA) standards.
4. Contractor Quality Control Engineer  
The Contractor Quality Control Engineer will focus primarily surveying and confirming that construction materials have been installed to the specified mix design, grades, and extents.

### ***Subcontractors***

1. Community Construction, Inc.  
GHD will contract CCI to install and grout the ACBM panels.
2. Morrison Surveying, Inc.  
GHD will contract Morrison Surveying to stake out the specified extents of the slope enhancement area and perform the pre-capping and post-capping surveys.

### ***Quality Assurance Program***

1. Task Description  
This project involves the installation of Articulated Concrete Block Mat in the slope enhancement area. The ACBM will be installed over approximately 3,630 square yards of the existing cap.
2. Performance Objectives and Criteria:
  - a. Verify Construction Materials:





- i. The Contractor Project Engineer will also inspect all materials brought to the construction areas for conformance to the Product Specifications. If materials do not conform to the Specifications, they will be replaced, as necessary.
  - ii. The concrete mix design is based on the ACBM Panel Manufacturer's recommendations. This mix design will ensure that the grout is sufficiently thixotropic and achieves the specified unconfined compressive strength. The concrete mix design is listed in Section 2 of this Construction Execution Plan.
- b. Place ACBM Panels in Correct Locations:
  - i. CTI will fabricate ACBM Panels to conform to the contours, grades, and extents identified by Anchor QEA (Anchor) in the "Northwest Cap Enhancement Area" .dwg file transmitted to GHD on December 20, 2018. The shop drawings contained in Appendix A include panel IDs and their corresponding locations. The Contractor Project Engineer will utilize a Trimble GPS Base and Rover System to verify the ACBM panels are installed to the grades, extents, and elevations contained in the Shop Drawing. Surveying will be used for quality control throughout ACBM installation activities.
  - ii. Sand bags will be used as temporary anchors for ACBM installed below the waterline. ACBM that extends onto the banks may be temporarily anchored with cables attached to stationary objects.
- c. Achieve Specified Grades and Extents:
  - i. The ACBM must be placed at the specified grades to the extents shown on Figures 2 to 4.
  - ii. CTI will fabricate ACBM panels so that one cubic yard of concrete will fill approximately 50 square feet of fabric in the AB600 panels. The surface areas and corresponding concrete fill volumes for each ACBM panel are noted in Table 1 of this Construction Execution Plan.
  - iii. GHD will closely monitor the area being covered by each ACBM panel and the corresponding concrete fill volume. The volume of concrete will reference receipts provided by the concrete supplier and check for compliance with the Shop Drawings included as Appendix A. The panel IDs, their surface areas, and the fill volume will be tracked in Table 2.
  - iv. Divers will be used to gauge the thickness of the panels and identify leaks. After the concrete has been allowed to cure for 48 hours, the Contractor Project Engineer will also probe the filled ACBM panels on 25-foot spacings.
  - v. Following the completion of ACBM installation, GHD and Morrison Surveying will perform a post-capping survey in order to generate an As-Built Package.



- vi. GHD will track and report the surface areas of the ACBM panels and the corresponding concrete fill volumes on a daily basis. The Daily Reports and Quality Control Tracking Form for ACBM Installation (Table 1) will provide sufficient proof that the specified concrete cap thicknesses have been achieved.
- d. Achieve Proper Stability of the ACBM Cap:
  - i. ACBM must be constructed to the grades shown on Figures 2 to 4, properly anchored, and monitored for stability throughout construction.
  - ii. In addition to surveying, intermittent probing, leak inspections, and surface area/fill volume tracking procedures described in the previous sections, GHD will also conduct daily visual inspections of the banks to ensure that the ACBM panels have not failed, slumped, and/or moved beyond the specified tolerances.
- di. Minimize Short-Term Water Quality Impacts:
  - i. GHD will install and maintain turbidity curtain, oil boom, and sorbent boom in areas upstream and downstream of the slope enhancement area.
- dii. Ensure Site Security:
  - i. GHD will ensure that the gate for the Site fence will be locked during non-working hours. Field offices and tool trailers will also be locked during non-working hours. Only essential project personnel will have access to lock codes and keys for the gate and trailers. Small equipment and hand tools will be stored within the locked tool trailers to prevent theft. The keys for heavy equipment and amphibious equipment will be removed and stored in the locked trailers at the end of each workday.
  - ii. GHD may contract Lofton Staffing to provide a security guard at the Site during non-working hours, if necessary.

## **7. Site Restoration and Demobilization**

GHD will anchor the grouted panels by installing 1.5 feet of rip rap above a 10-foot wide by 505-foot long section of the ACBM. GHD will install up to 562 tons of rip rap above the grouted ACBM panels. Additionally, all residual concrete grout will be washed out of the pump and hoses into a 25 cubic yard roll off box. This grout will be allowed to cure sufficiently before it is added to the rip rap apron.

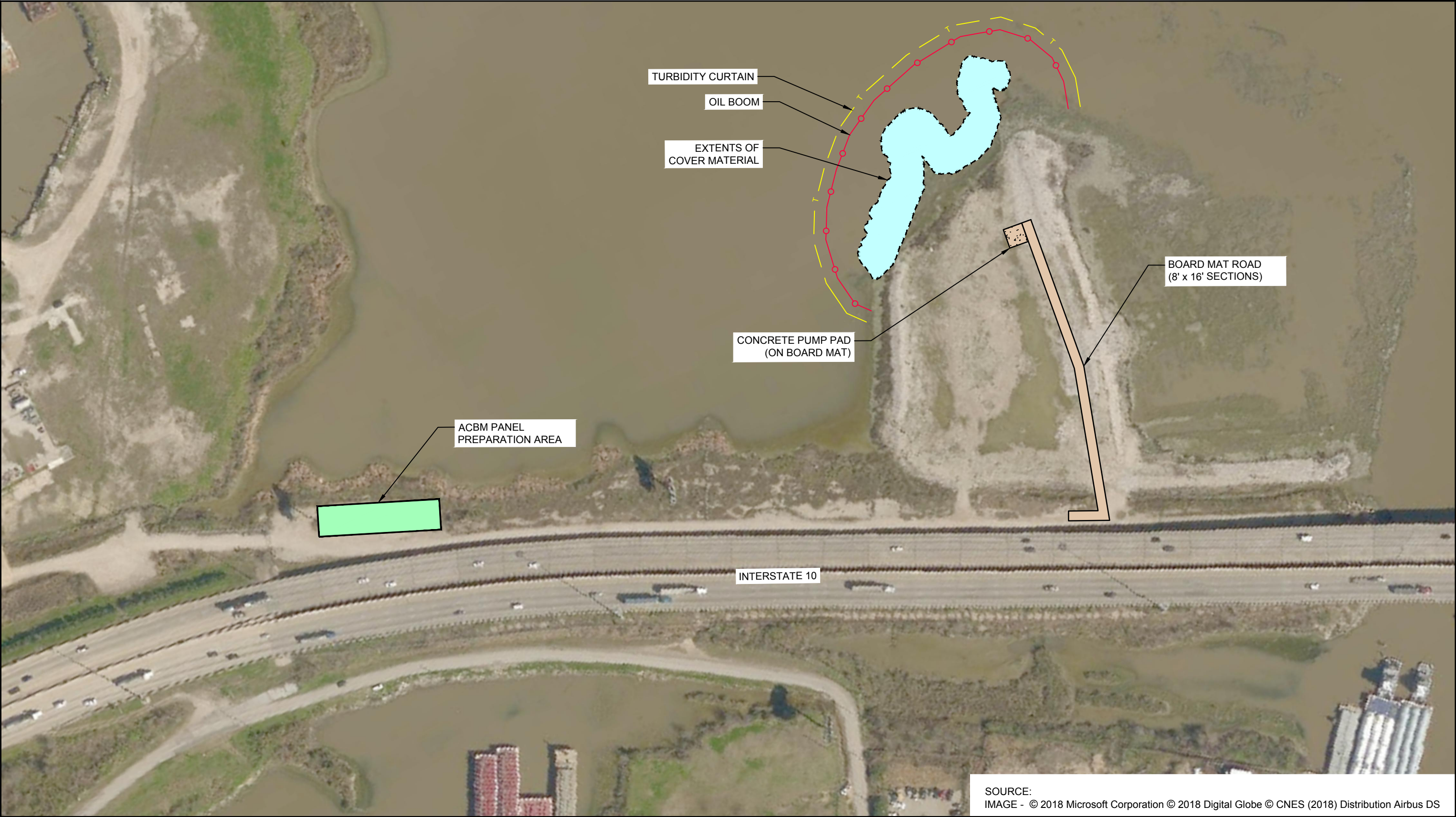
After the rip rap cover has been installed above the ACBM, GHD will remove and load out all board mats.

GHD and Morrison Surveying will conduct an as-built survey of the slope enhancement area and produce a detailed drawing package that clearly shows that all ACBM panels were installed to the specified extents.

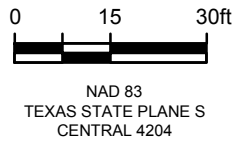
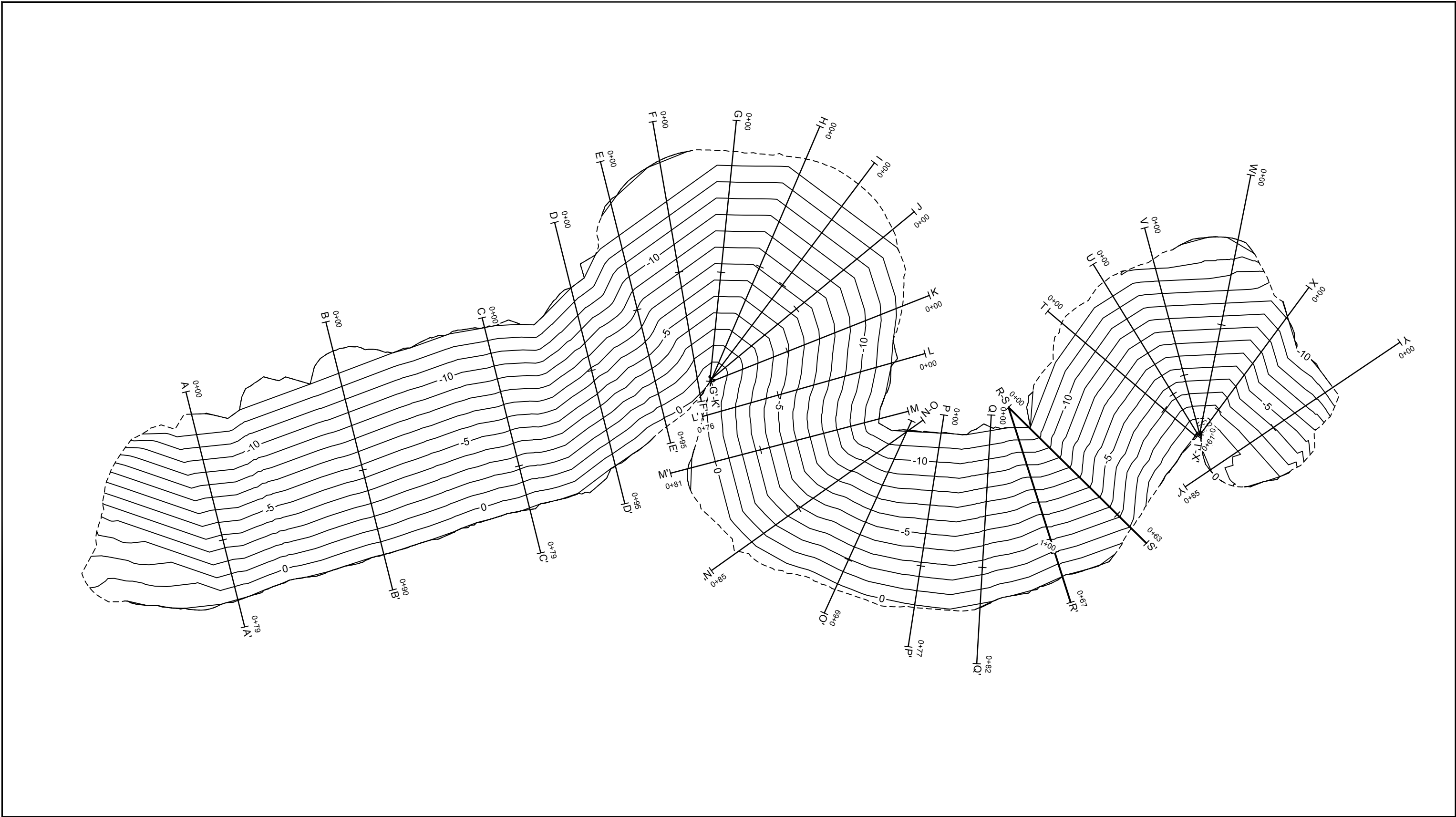




GHD will demobilize all personnel, equipment, and subcontractors after demonstrating that the project has been completed to the satisfaction of the Owners.





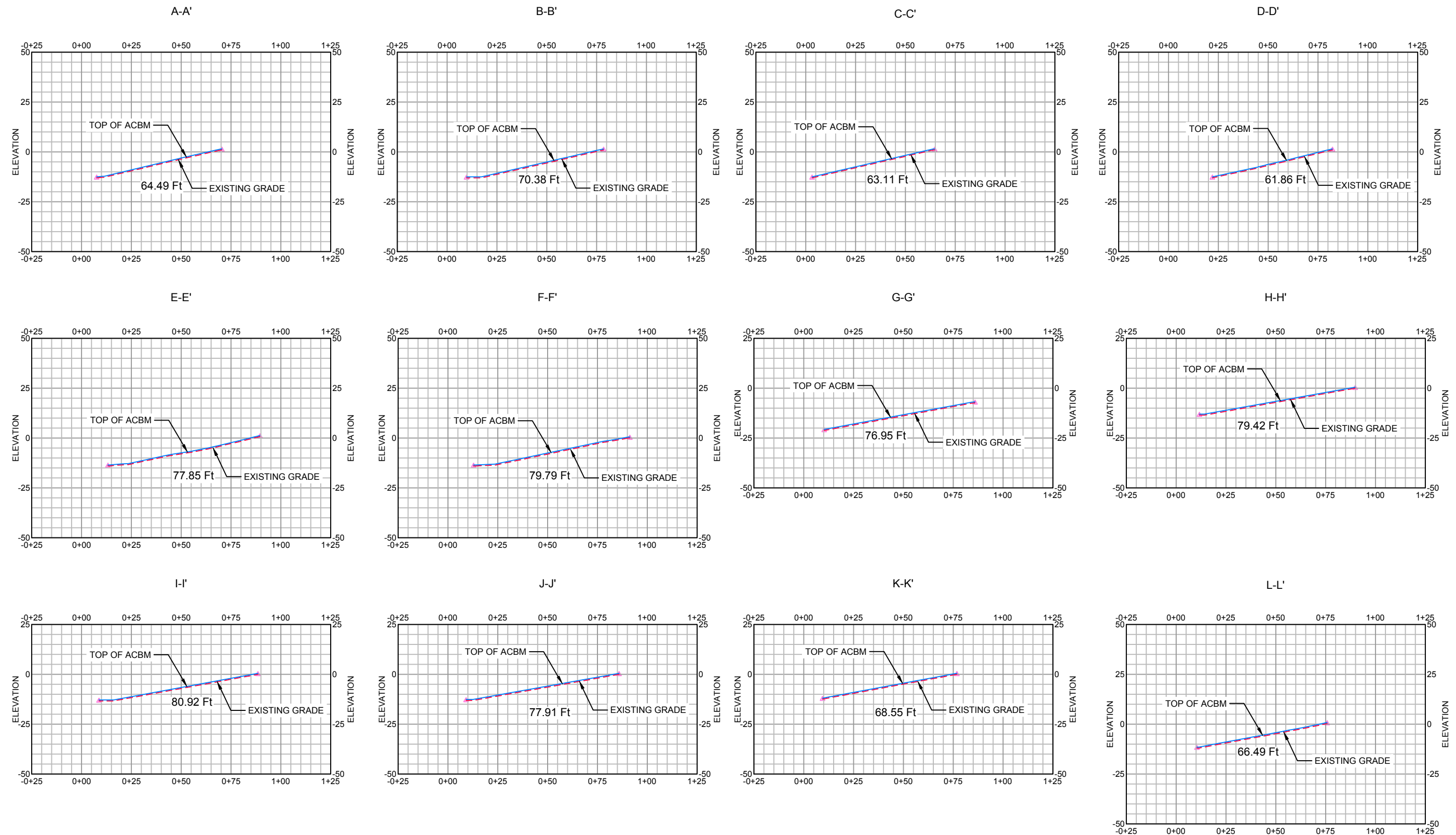


SAN JACINTO RIVER WASTE PITS  
NORTHWEST CORNER SLOPE ENHANCEMENT

ARTICULATED CONCRETE BLOCK MAT  
PLAN VIEW

1191381-00  
Mar 4, 2019

FIGURE 2

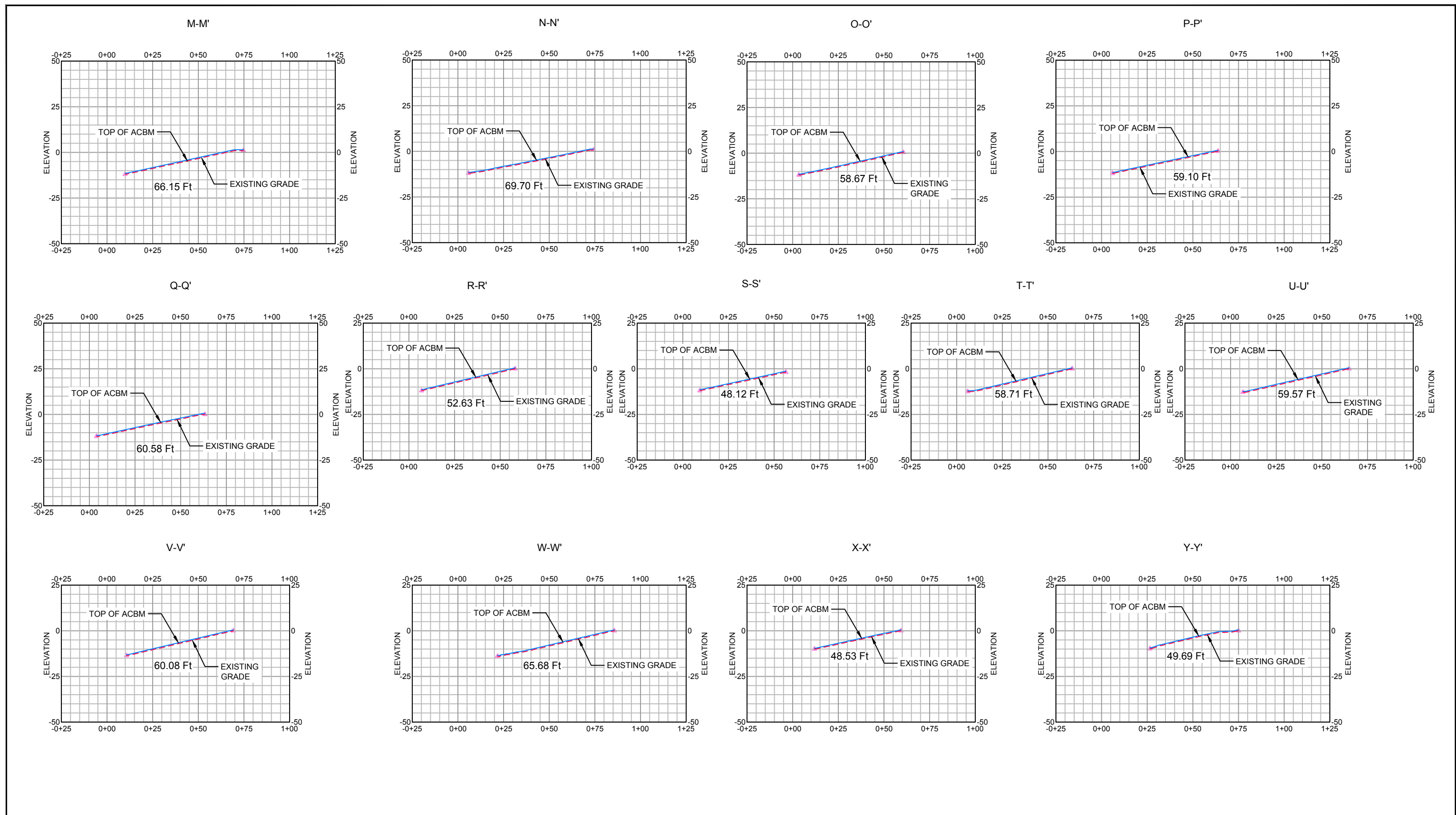


SAN JACINTO RIVER WASTE PITS  
NORTHWEST CORNER SLOPE ENHANCEMENT

ARTICULATED CONCRETE BLOCK MAT  
CROSS SECTIONS - 1 OF 2

1191381-00  
Mar 4, 2019

FIGURE 3



SAN JACINTO RIVER WASTE PITS  
NORTHWEST CORNER SLOPE ENHANCEMENT

ARTICULATED CONCRETE BLOCK MAT  
CROSS SECTIONS - 2 OF 2

1191381-00

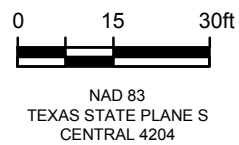
Mar 4, 2019

FIGURE 4



NOTE:

CAST IN PLACE SURFACE AREA WITHOUT OVERLAPS APPROX. 3877 SQ. YD.  
 CAST IN PLACE SURFACE AREA WITH OVERLAPS APPROX. 4100 SQ. YD



SAN JACINTO RIVER WASTE PITS  
 NORTHWEST CORNER SLOPE ENHANCEMENT

ACBM PANEL LAYOUT  
 PLAN VIEW

1191381-00  
 Mar 4, 2019

FIGURE 5



Table 1

**San Jacinto Northwest Slope Enhancements  
Volume and Surface Area Summaries for Mats**

Mat ID	Target CIP Volume (cubic yards)	Panel Surface Area (square feet)	CIP Surface Area (square feet)	CIP Surface Area (square yards)	Cover Thickness (feet)	CIP Volume (cubic feet)	Shape Factor
101	32.0000	2121	1632	181	0.5000	816	50.00
201	19.0000	1256	967	107	0.5000	484	50.00
202	24.0000	1560	1201	133	0.5000	600	50.00
203	25.0000	1655	1274	142	0.5000	637	50.00
204	27.0000	1763	1357	151	0.5000	679	50.00
205	25.0000	1667	1283	143	0.5000	642	50.00
206	25.0000	1631	1256	140	0.5000	628	50.00
207	28.0000	1834	1412	157	0.5000	706	50.00
208	29.0000	1941	1494	166	0.5000	747	50.00
209	26.0000	1740	1338	149	0.5000	669	50.00
210	23.0000	1501	1155	128	0.5000	578	50.00
301	36.0000	2346	1806	201	0.5000	903	50.00
302	29.0000	1917	1476	164	0.5000	738	50.00
303	31.0000	2048	1577	175	0.5000	788	50.00
304	30.0000	2013	1549	172	0.5000	775	50.00
305	28.0000	1834	1412	157	0.5000	706	50.00
401	33.0000	2191	1687	187	0.5000	843	50.00
402	30.0000	2013	1549	172	0.5000	775	50.00
403	27.0000	1763	1357	151	0.5000	678	50.00
404	26.0000	1725	1329	148	0.5000	665	50.00
405	27.0000	1763	1357	151	0.5000	678	50.00
406	28.0000	1858	1430	159	0.5000	715	50.00
407	28.0000	1858	1430	159	0.5000	715	50.00
408	27.0000	1810	1393	155	0.5000	697	50.00
409	26.0000	1740	1338	149	0.5000	669	50.00
410	25.0000	1632	1256	140	0.5000	628	50.00
411	12.0000	834	642	71	0.5000	321	50.00
<b>Target Totals</b>	<b>726.0000</b>	<b>48014</b>	<b>36957</b>	<b>4106</b>		<b>18478</b>	

Table 2

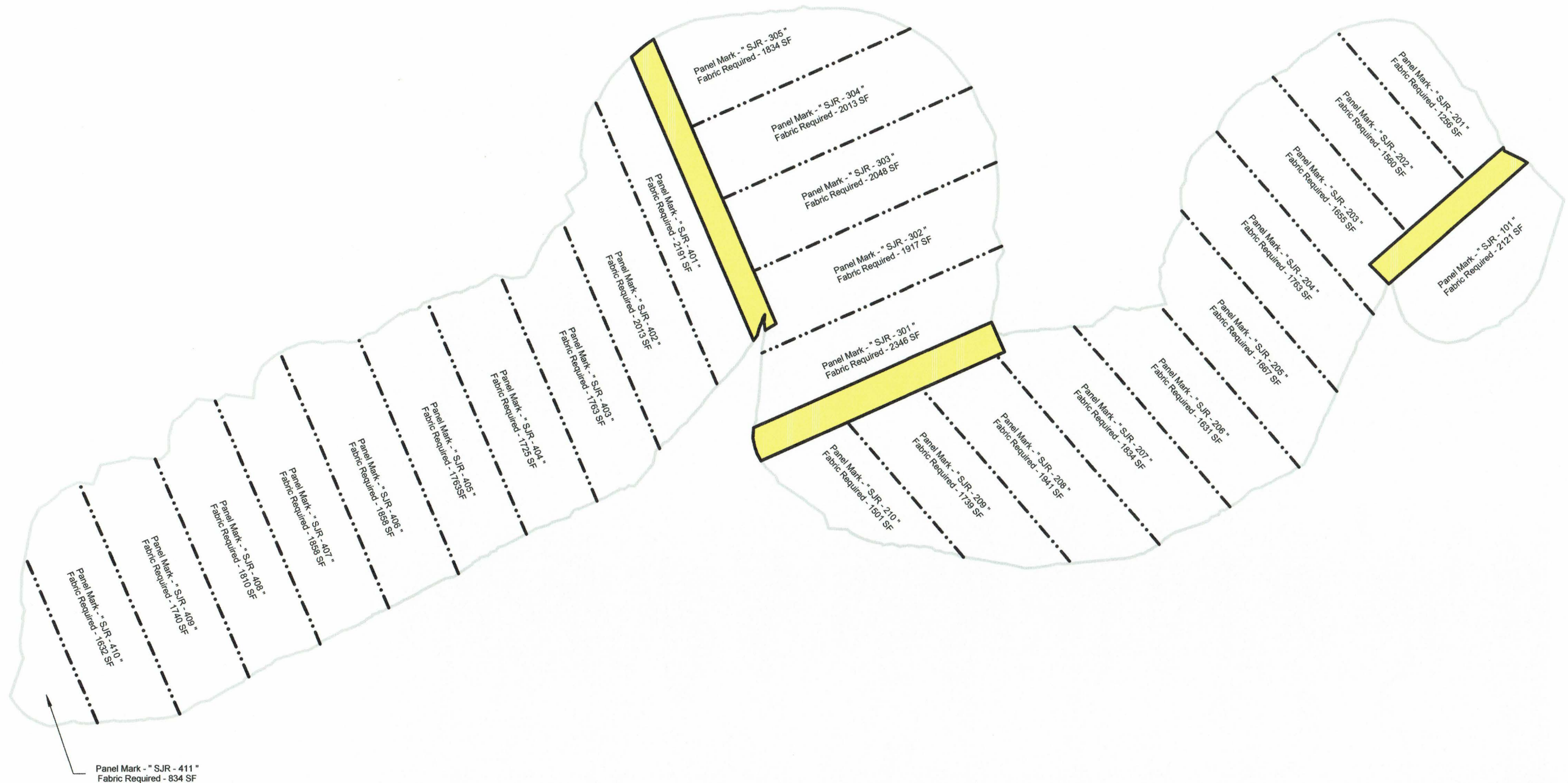
**San Jacinto Northwest Slope Enhancement  
Panel and Grout Tracking**

Date	Panels Grouted	Ticket Numbers	Actual Volume (cubic yards)	Running Actual (cubic yards)	Notes
<b>Target Volume (cubic yards):</b>	<b>726.0</b>		<b>Actual Volume (cubic yards):</b>	<b>0.0</b>	

# Appendices

# **Appendix A**

## **Articulated Concrete Block Mat Shop Drawings**



 - 5' MINIMUM OVERLAP



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CONSTRUCTION  
TECHNIQUES, INC.  
15887 SNOW ROAD  
SUITE 100  
CLEVELAND, OHIO 44142  
1-800-563-5047  
www.fabriform1.com

APPROVED:	DATE:
APPROVED:	DATE:

CLIENT:



PIPELINE & EROSION  
CONTRACTOR

CCI

1045 PANTHER RIDGE PARKWAY  
HAZLEHURST, MS 39083

(601) 894-5133

PROJECT:

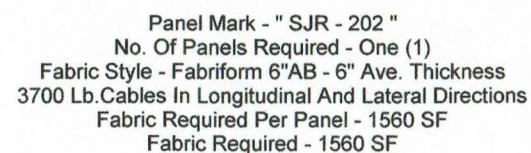
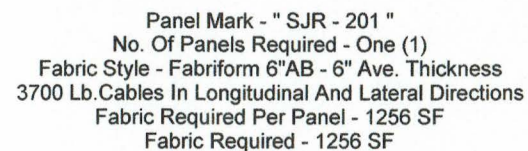
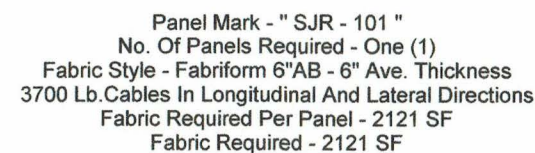


SAN JACINTO RIVER WASTE PITS  
NORTHWEST CORNER  
SLOPE ENHANCEMENT  
FABRIFORM ABM REVETMENT  
PANEL LAYOUT DRAWING

PROJECT  
NO. X 0120

SHEET NO.  
1





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APPROVED:	DATE:
APPROVED:	DATE:



**PELINE & EROSION**  
**CONTRACTORS**

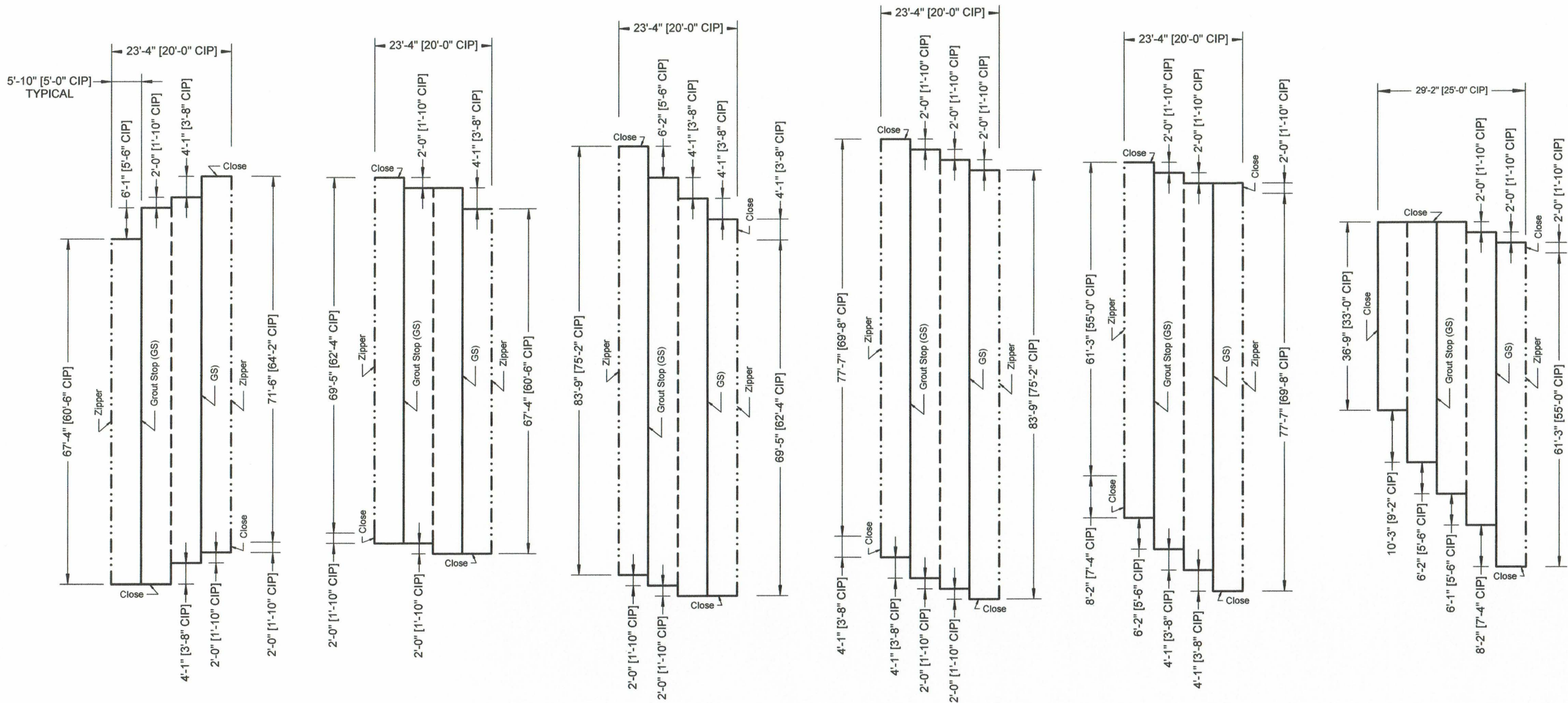


SAN JACINTO RIVER WASTE PITS  
NORTHWEST CORNER  
SLOPE ENHANCEMENT  
FABRIFORM ABM REVETMENT  
PANEL DETAILS  
PANELS SJR - 101 &  
SJR - 201 THROUGH SJR - 204

PROJECT  
NO. X 0120

SHEET NO.  
2





Panel Mark - " SJR - 206 "

No. Of Panels Required - One (1)

Fabric Style - Fabriform 6"AB - 6" Ave. Thickness

3700 Lb.Cables In Longitudinal And Lateral Directions

Fabric Required Per Panel - 1631 SF

Fabric Required - 1631 SF

Panel Mark - " SJR - 205 "

No. Of Panels Required - One (1)

Fabric Style - Fabriform 6"AB - 6" Ave. Thickness

3700 Lb.Cables In Longitudinal And Lateral Directions

Fabric Required Per Panel - 1667 SF

Fabric Required - 1667 SF

Panel Mark - " SJR - 207 "

No. Of Panels Required - One (1)

Fabric Style - Fabriform 6"AB - 6" Ave. Thickness

3700 Lb.Cables In Longitudinal And Lateral Directions

Fabric Required Per Panel - 1834 SF

Fabric Required - 1834 SF

Panel Mark - " SJR - 208 "

No. Of Panels Required - One (1)

Fabric Style - Fabriform 6"AB - 6" Ave. Thickness

3700 Lb.Cables In Longitudinal And Lateral Directions

Fabric Required Per Panel - 1941 SF

Fabric Required - 1941 SF

Panel Mark - " SJR - 209 "

No. Of Panels Required - One (1)

Fabric Style - Fabriform 6"AB - 6" Ave. Thickness

3700 Lb.Cables In Longitudinal And Lateral Directions

Fabric Required Per Panel - 1740 SF

Fabric Required - 1740 SF

Panel Mark - " SJR - 210 "

No. Of Panels Required - One (1)

Fabric Style - Fabriform 6"AB - 6" Ave. Thickness

3700 Lb.Cables In Longitudinal And Lateral Directions



Fabric Required Per Panel - 1501 SF

Fabric Required - 1501 SF

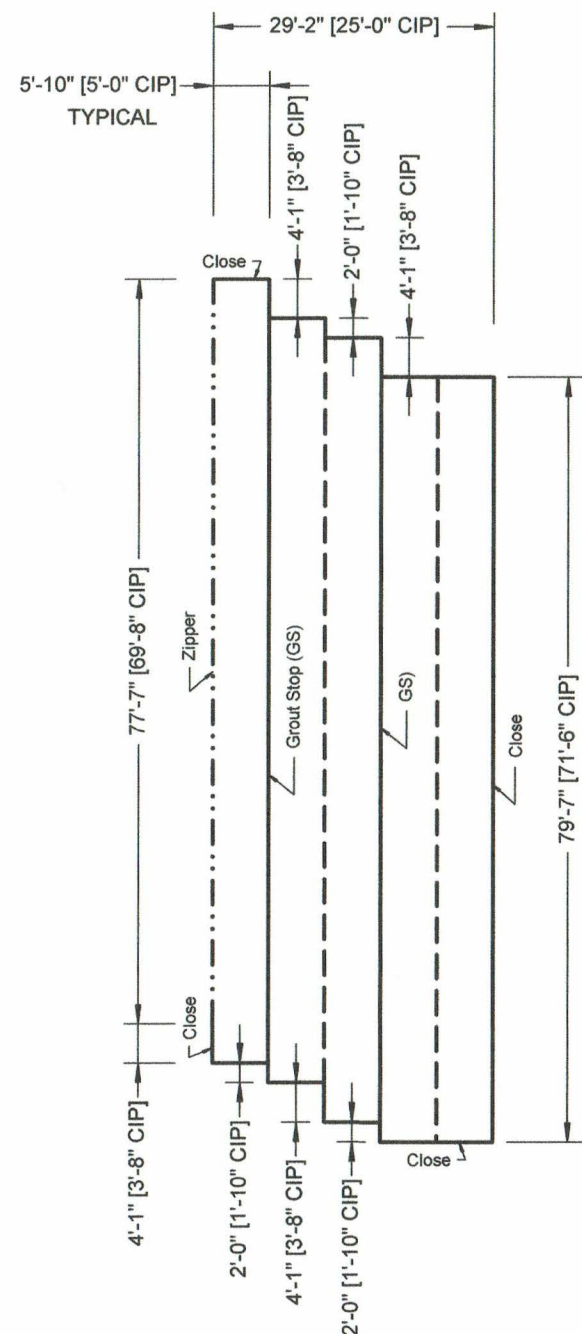
NOTE (1) CIP REFERS TO CAST IN PLACE LENGTH AFTER INSTALLATION CONTRACTION.

(2) EXTEND LONGITUDINAL CABLES 3' LONGER THAN CIP LENGTH AT TOP AND BOTTOM EDGES.

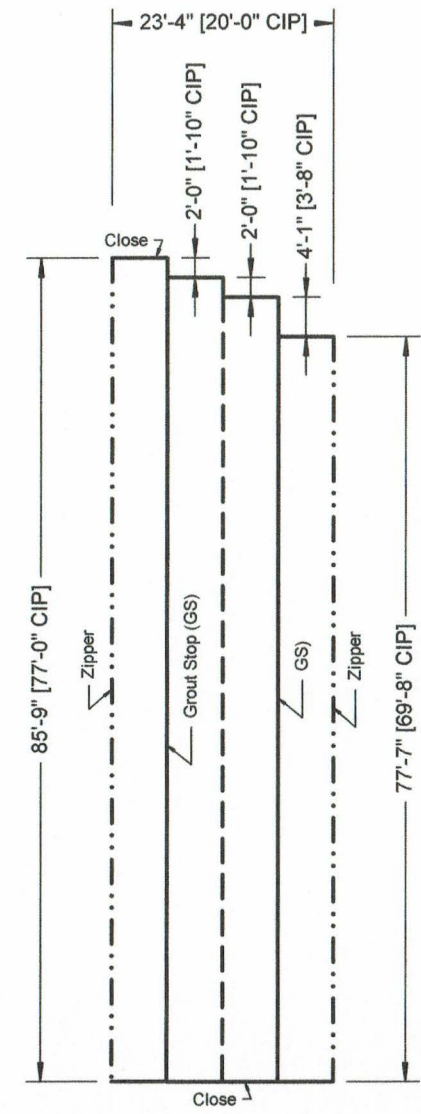
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	APPROVED:	DATE:			

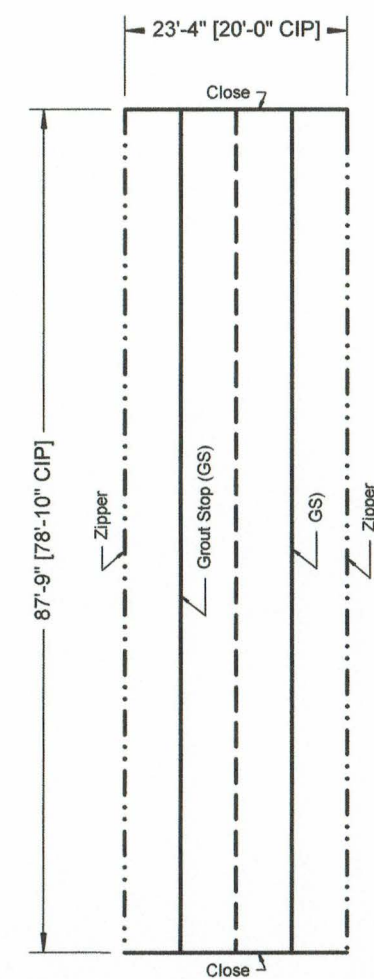




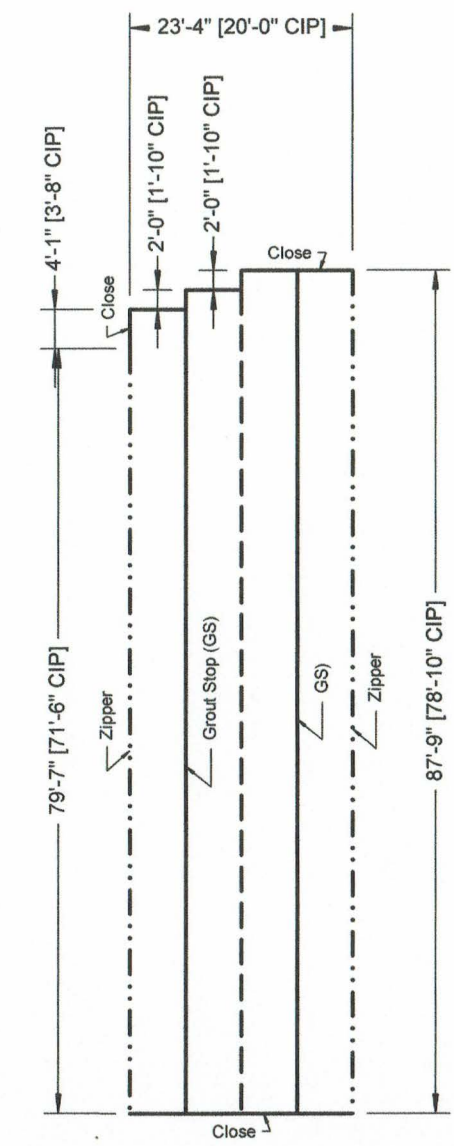
Panel Mark - " SJR - 301 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 2346 SF  
 Fabric Required - 2346 SF



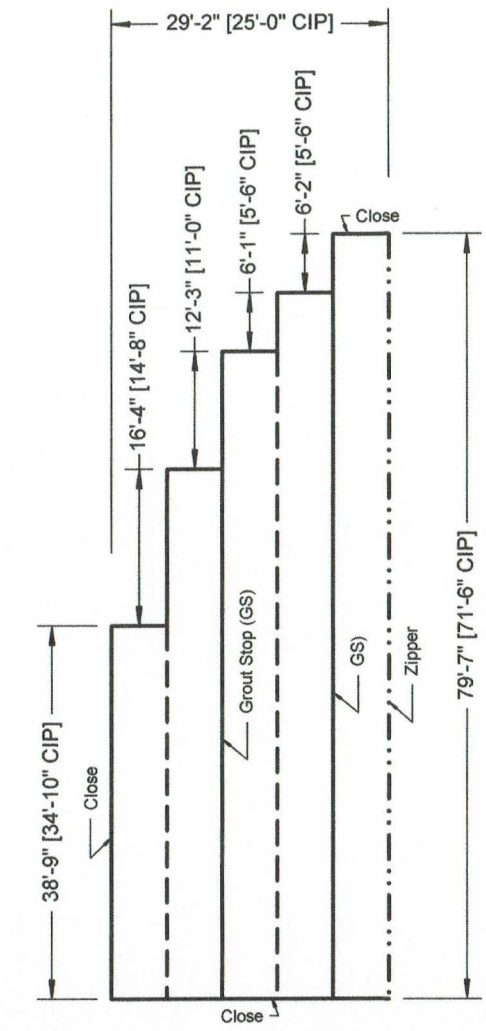
Panel Mark - " SJR - 302 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 1917 SF  
 Fabric Required - 1917 SF



Panel Mark - " SJR - 303 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 2048 SF  
 Fabric Required - 2048 SF





Panel Mark - " SJR - 304 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 2013 SF  
 Fabric Required - 2013 SF



Panel Mark - " SJR - 305 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 1834 SF  
 Fabric Required - 1834 SF

NOTE (1) CIP REFERS TO CAST IN PLACE LENGTH AFTER INSTALLATION CONTRACTION.  
 (2) EXTEND LONGITUDINAL CABLES 3' LONGER THAN CIP LENGTH AT TOP AND BOTTOM EDGES.

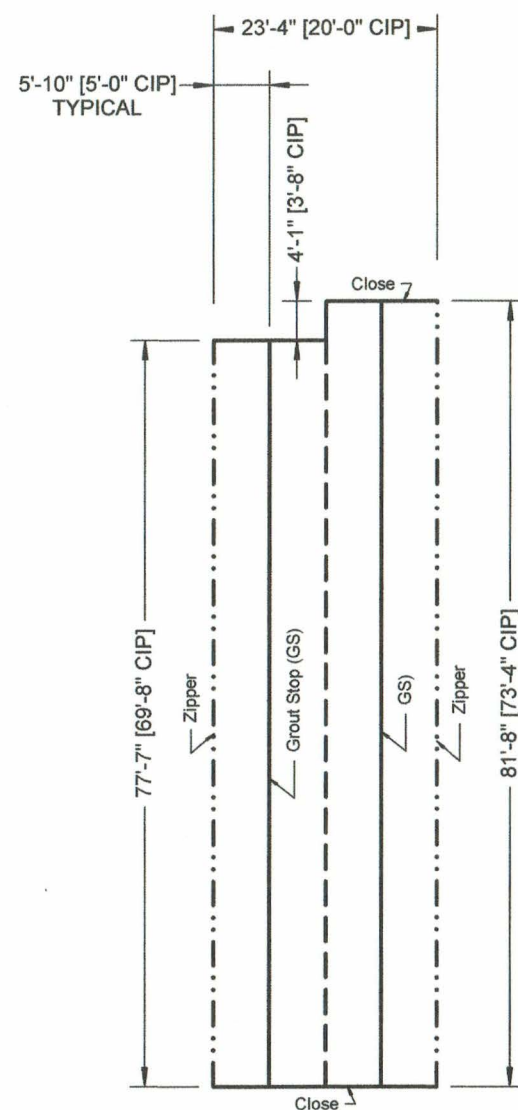
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CONSTRUCTION TECHNIQUES, INC. 15887 SNOW ROAD SUITE 100 CLEVELAND, OHIO 44142 1-800-563-5047 www.fabriform1.com	APPROVED:	DATE:	CLIENT:  CCI 1045 PANTHER RIDGE PARKWAY HAZLEHURST, MS 39083 (601) 894-5133	PROJECT:  SAN JACINTO RIVER WASTE PITS NORTHWEST CORNER SLOPE ENHANCEMENT FABRIFORM ABM REVETMENT PANEL DETAILS PANELS SJR - 301 THROUGH SJR - 305	PROJECT NO. X 0120  SHEET NO. 4
	APPROVED:	DATE:			

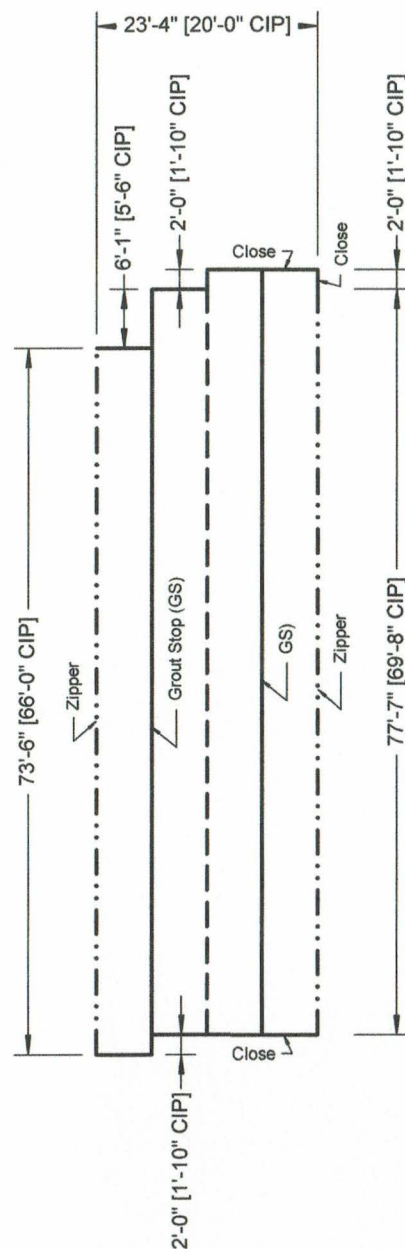




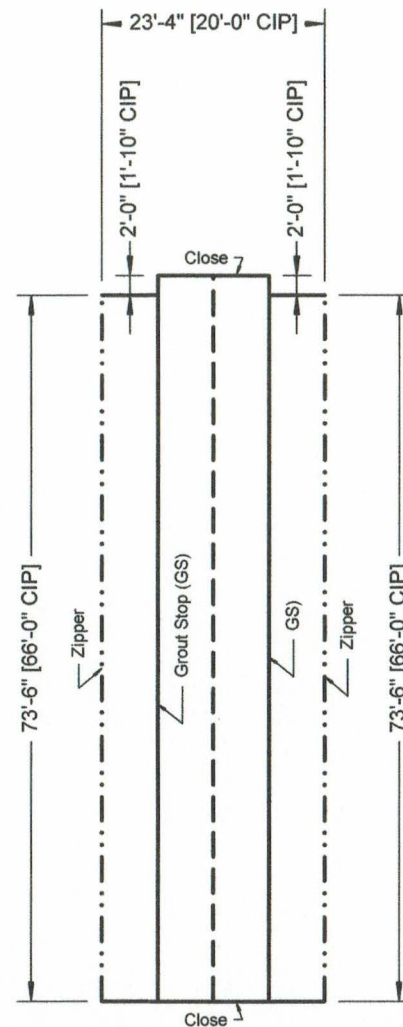




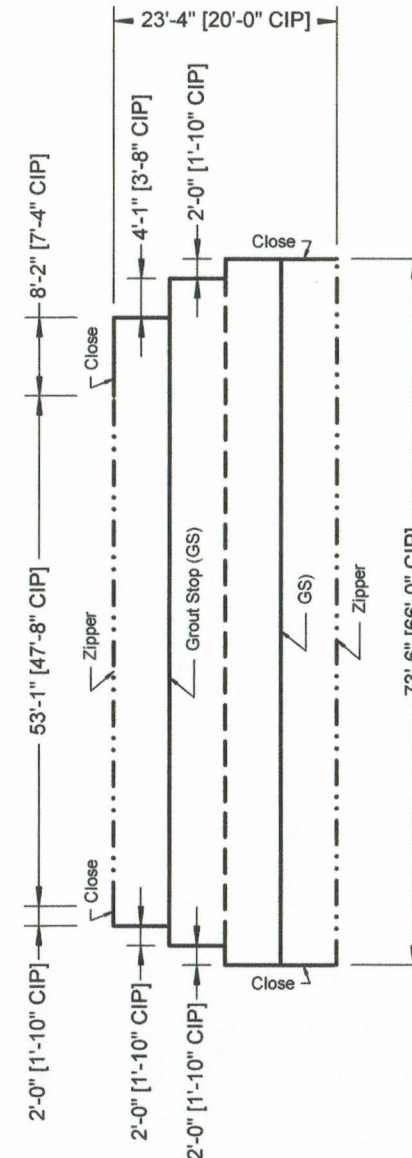
Panel Mark - " SJR - 407 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 1858 SF  
 Fabric Required - 1858 SF



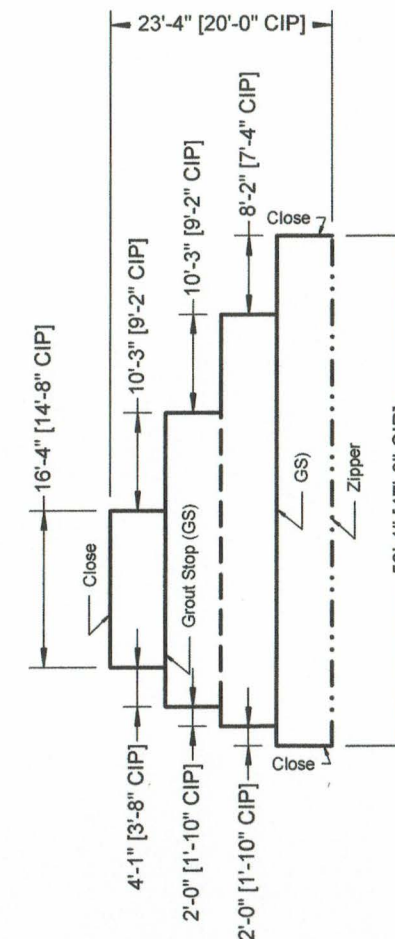
Panel Mark - " SJR - 408 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 1810 SF  
 Fabric Required - 1810 SF



Panel Mark - " SJR - 409 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 1740 SF  
 Fabric Required - 1740 SF



Panel Mark - " SJR - 410 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 1632 SF  
 Fabric Required - 1632 SF



Panel Mark - " SJR - 411 "  
 No. Of Panels Required - One (1)  
 Fabric Style - Fabriform 6"AB - 6" Ave. Thickness  
 3700 Lb.Cables In Longitudinal And Lateral Directions  
 Fabric Required Per Panel - 834 SF  
 Fabric Required - 834 SF

NOTE (1) CIP REFERS TO CAST IN PLACE  
 LENGTH AFTER INSTALLATION CONTRACTION.  
 (2) EXTEND LONGITUDINAL CABLES 3' LONGER  
 THAN CIP LENGTH AT TOP AND BOTTOM EDGES.

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 APPROVED: DATE:

CLIENT:



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 1045 PANTHER RIDGE PARKWAY  
 HAZLEHURST, MS 39083  
 (601) 894-5133

PROJECT:



SAN JACINTO RIVER WASTE PITS  
 NORTHWEST CORNER  
 SLOPE ENHANCEMENT  
 FABRIFORM ABM REVETMENT  
 PANEL DETAILS  
 PANELS SJR - 407  
 THROUGH SJR - 411

PROJECT  
 NO. X 0120

SHEET NO.  
 6

## **Appendix B**

# **Articulated Concrete Block Mat Specifications**



The FABRIFORM® Process utilizes a double-layer, 100% nylon fabric form, especially woven for optimum strength, stability, adhesion, and filtering characteristics, combined with a highly fluid fine aggregate concrete (grout) to provide an economical hard armor solution for erosion control. Fabriform revetments can be cast underwater as well as in-the-dry.

## Fabriform® Articulating Block Technical Data

DESIGNS BASED ON OVER 40 YEARS OF EXPERIENCE

A 3D perspective diagram of a single articulating block. The block is rectangular with rounded ends and features a series of small, dark, circular protrusions along its top and side edges, representing cables. Dimension lines indicate the length 'L' and width 'W'. Two arrows point to the block: one labeled 'Transverse Cables (optional)' pointing to the side cables, and another labeled 'Slope Cables' pointing to the top cables.

Designation Style	CAST-IN-PLACE							
	Block Size (LxW)*		Average Thickness**		Coverage Per		Dry Weight***	
	in.	mm	in.	mm	Y <sup>3</sup> Mortar	M <sup>3</sup> Mortar	lb / ft <sup>2</sup>	kg / m <sup>2</sup>
4" ABNN	20 x 12	500 x 300	4	100	75 ft <sup>2</sup>	9.11 m <sup>2</sup>	45	220
6" ABNN	20 x 20	500 x 500	6	150	50 ft <sup>2</sup>	6.07 m <sup>2</sup>	68	330
8" ABNN	40 x 20	1000 x 500	8	200	38 ft <sup>2</sup>	4.55 m <sup>2</sup>	90	440
10" ABNN	40 x 30	1000 x 750	10	250	31 ft <sup>2</sup>	3.76 m <sup>2</sup>	113	550
12" ABNN	40 x 40	1000 x 1000	12	300	25 ft <sup>2</sup>	3.03 m <sup>2</sup>	135	660

\* Dimensions shown are nominal net cast-in-place block sizes, without articulating hinges. Articulating hinges are approximately 1.5" (37.5 mm) wide and provide relief for hydrostatic pressures.

\*\* Nominal; maximum thickness of blocks will be greater.

\*\*\* Dry Weight based on a specific weight of 2.1 or 135 lb/cf. Unit Weight may vary with material proportions and source.

Articulating Block (AB) revetment fabric is a form for casting in place heavy-duty, rectangular concrete blocks in a staggered joint pattern. AB revetments may be reinforced by cables inserted between the two layers of fabric prior to fine aggregate concrete (grout) injection. Reinforcing cables interlock the cast-in-place concrete blocks when the AB revetment articulates due to changing soil and water conditions. Un-reinforced AB revetments should only be used where minimal settlement is anticipated and a high coefficient of hydraulic friction is required.

AB revetment fabrics are a woven, double-layered fabric of 100% high-tenacity, multifilament nylon of which at least 50% by weight consists of textured fibers for optimum filtering characteristics and adhesion to the grout. Nylon yarns also provide a relatively high resistance to ultraviolet light and alkali degradation. Block thickness is controlled by spacer cords in the middle of each block. Lateral flow of grout is controlled by shop-installed bulk-heads (grout stops) located at predetermined intervals as required.

The AB revetment fabric is shop-assembled in predetermined panel sizes to fit site topography. The panels are convenient to handle and are joined together side-by-side at the job site by means of sewing or zipper closures attached to both the upper and lower layers of fabric. Reinforcing cables, which are installed perpendicular to block length, are referred to as "slope cables." Transverse cables, parallel to block length, may also be inserted if required. Final selection of cable(s) for each job is at the discretion of the Engineer (Designer).

The panels will contract when they are injected with grout. Allowance must be made for this contraction when preparing shop drawings of panel assemblies. Contraction will vary with site conditions. For budgetary estimates, a minimum contraction allowance should be made for approximately 23% additional fabric to cover the cast-in-place area.

### NOTE:

Information contained in this publication is offered in good faith as a guide to placement of Fabriform® erosion control revetments. It is based on experience obtained under a variety of conditions. However, information contained herein will not apply to every job and dimensions and quantities shown are approximate only and will vary as a result of site conditions and installation procedures. The user is cautioned to obtain from others such professional and technical services as may, in his own judgment, be necessary or desirable to insure effective and economical installations.

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# Guide Specifications: Fabriform® Articulating Block Fabric and Revetment Installation

PAGE 2 OF 4

## I. GENERAL

### A. Scope of Work

The work shall consist of furnishing all labor, materials, and equipment for installing fabric-formed concrete revetment as indicated in the contract drawings and specified herein.

### B. Description

The work shall consist of installing a reinforced (or un-reinforced) concrete revetment, as indicated in the contract drawings, by positioning a specially woven, dual wall, 100% nylon fabric form on the slope or surface to be protected and injecting it with fine aggregate concrete (grout). The surfaces to be protected shall be prepared and graded to such an extent that they are normally stable in the absence of erosive forces.

### C. Qualification of Contractor

The Contractor shall furnish records of past successful experience in performing this type of work. The Contractor shall save the Owner harmless from liability of any kind arising from the use of any patented or unpatented invention in the performance of this work.

## II. MATERIALS

### A. Fiber and Fabric Specifications

Fiber and fabric materials shall meet the minimum requirements, as listed and reported by an independent testing agency, shown below:

PROPERTY	TEST METHOD	UNIT	VALUE	
<b>PHYSICAL</b>				
Composition			NYLON	
Weight (both layers)	ASTM D-5261	oz/yd (g/m)	13 (440)	
Thickness	ASTM D-5199	mils (mm)	30 (0.76)	
<b>MECHANICAL</b>				
Grab Tensile Strength	ASTM D-4632	lbf (N)	WARP FILL	400 (1780) 300 (1330)
Grab Tensile Elongation			ASTM D-4632	%
Wide Width Strip Tensile Strength	ASTM D-4595	lbf/in (kN/m)	WARP FILL	300 (52.5) 275 (48)
Elongation At Break			ASTM D-4595	%
Trapezoidal Tear Strength	ASTM D-4533	lbf (N)	WARP FILL	175 (775) 150 (665)
<b>HYDRAULIC</b>				
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Standard (mm)	40 (0.425)	
Flow Rate	ASTM D-4491	gal/min/sf (l/min/m)	90 (3665)	

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# Guide Specifications: Fabriform® Articulating Block Fabric and Revetment Installation

PAGE 3 OF 4

## B. Fabric Design

Fabric-forming material shall consist of double-layer, open-selvage fabric joined in a mat configuration. Fabric shall be woven of 100% high-tenacity, continuous multifilament nylon of which at least 50% by weight shall be textured fiber. Polyester, staple, and partially orientated yarn shall not be allowed. The tensile strength of spacer cords used to control block thickness shall total not less than 600 lbs (2.7kN) at each section of control.

Fabric, designated as \_\_\_\_\_ ABNN on the drawings, shall be woven in such a manner as to provide articulation joints, surrounding fine aggregate concrete-filled blocks measuring approximately \_\_\_\_\_" x \_\_\_\_\_" x \_\_\_\_\_". (See Note 1 below.) Block thickness shall be measured as described in Section III.D of this specification.

*NOTE 1: Designer will indicate here the fabric designation required from choice of fabric styles listed below. Fabric style designates approximate nominal thickness and size:*

*4" ABNN – 4" x 20" x 12" (100mm x 500mm x 300mm); 6" ABNN – 6" x 20" x 20" (150mm x 500mm x 500mm);*

*8" ABNN – 8" x 40" x 20" (200mm x 1,000mm x 500mm); 10" ABNN – 10" x 40" x 30" (250mm x 1,000mm x 750mm);*

*12" ABNN – 12" x 40" x 40" (300mm x 1,000mm x 1,000mm)*

The two layers of fabric shall be connected at the center of each block with spacer cords of such a length as to positively control thickness of the finished block and to produce a pronounced corrugation in the surface of the form, when filled, to serve as evidence of complete and uniform filling of the fabric block form. Articulation joints between adjacent blocks shall be staggered in such a manner as to avoid formation of a continuous channel from top to bottom of the slope.

Forms for individual blocks shall be interconnected with conduits, top, bottom, and sides to allow for passage of fluid grout between all adjacent blocks and to provide a sheath for protection of cables, if required, between adjacent blocks. Cast-in-place distance between conduits is approximately 10" (250mm) in the slope direction and 12" (300mm) in the transverse direction. The flat width of each conduit as woven shall be not less than 3" (75mm) or more than 5" (125mm).

## C. Fabric Porosity

Fabric porosity is essential for the successful execution of this work. At the direction of the Engineer, the Contractor shall demonstrate the suitability of fabric design by injecting the proposed grout into 5½" (140 mm) diameter sleeves. The sleeves shall be constructed of a single layer of the same basic fabric material. Test cylinders, 12" (300 mm) long, shall be cut from each specimen and tested in accordance with ASTM C-39. This test will be run once at the start of the project unless otherwise directed by the engineer. (See Item G below).

## D. Relief of Hydrostatic Uplift

Fabric, designated as \_\_\_\_\_ ABNN on the drawings, shall be woven in such a manner as to provide interwoven bands of attachments between blocks. These bands shall control the length and width block dimensions and also act as filter strips to provide relief of hydrostatic uplift beneath the completed revetment.

## E. Tensile Reinforcing Members (if required)

Tensile reinforcing members (cables), where required, shall be threaded through cable conduits between adjacent blocks. Cables, when used, are normally threaded through every conduit parallel to the slope. Transverse cables may also be threaded through conduits perpendicular to the slope, at the option of the designer. Slope cables shall consist of \_\_\_\_\_ dia. on approximately \_\_\_\_\_ in. ( \_\_\_\_\_ mm) centers cast-in-place. Transverse cables shall consist of \_\_\_\_\_ dia. on approximately \_\_\_\_\_ in. ( \_\_\_\_\_ mm) centers cast-in-place. (See Note 3 below).

Where necessary, cables shall be joined by means of copper connectors. Aluminum connectors in direct contact with cement grout will not be permitted. All cables shall be completely embedded in the hardened grout. Exposed cables between adjacent blocks will not be permitted.

*Note 3: Designer normally specifies 11/32" diameter (27mm circumference) nylon cable with 5,200 lb. breaking strength. Other types of cable may be specified such as 1/4" diameter (20mm circumference) polyester cable with 3,700 lb. breaking strength. Cable spacing must be a multiple of conduit spacing as called for in Section II. B.*

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# Guide Specifications: Fabriform® Articulating Block Fabric and Revetment Installation

PAGE 4 OF 4

## F. Fabric Assembly

AB Fabric shall be factory assembled into predetermined panel sizes. The AB fabric rolls are first cut into the lengths specified on the shop drawings. These fabric pieces are then joined together, top layer to top layer and bottom layer to bottom layer. This will allow for the finished revetment to have the full block thickness between the top and bottom seam. A single seam in which all four layers of fabric are joined at one point will not be permitted. All factory seams shall face downwards and shall be made using a double-needled machine utilizing the Standard Type 401 stitch. Zipper closures shall be attached to the sides of the AB panels as required for connection of adjacent panels at the site location. If required, bulkheads (grout stops) may be installed parallel to and in between individual mill widths at predetermined intervals to regulate the flow of fine aggregate concrete. Grout stops shall be designed as to produce full block thickness along the full length of the grout stop. Completed AB panels shall be inspected to verify that full block dimensions are maintained throughout the panel.

## G. Fine Aggregate Concrete (Grout)

Fine aggregate concrete (grout) shall consist of a mixture of portland cement, fine aggregate, and water so proportioned and mixed as to provide a readily flowable grout. Admixtures and/or a pozzolan may be used with the approval of the Engineer. Use of super plasticizers requires special precautions; silica fume is not recommended. The hardened fine aggregate concrete shall exhibit a compressive strength of 2,500 psi (17 MPa) at 28 days when specimens are made and tested according to the provisions of ASTM C-31 and C-39. The average compressive strength of fabric cast test cylinders, as described in Paragraph C above, shall be at least 20% higher at 7 days than that of companion test cylinders made in accordance with ASTM C-31, and not less than 3,000 psi (21 MPa) at 28 days.

## III. INSTALLATION

### A. Fabric Storage

Immediately following receipt of fabric on the job site, fabric shall be inspected and stored in a clean, dry area where it will not be subject to mechanical damage or exposure to moisture or direct sunlight. Fabric allowed to become wet and then dried before installation may be subject to shrinkage.

### B. Site Preparation

The surface to be protected shall be constructed to the line and dimensions as shown on the contract drawings. The area shall be free of all obstruction and organic material, such as rocks and roots. Areas below grade shall be brought to grade using engineered fill or a drainage stone as specified by the Engineer. Anchor and flank trench installation will be in accordance with project plans and specifications.

### C. Fabric Placement

The AB fabric panels shall be positioned over a geotextile filter fabric, as specified by the Engineer, and zipped together at their approximate design location, making the appropriate allowance for approximately 11% contraction of the fabric in each direction which will occur as a result of grout injection. Cables shall be securely attached to the ground anchor system at the crown of the slope to prevent slippage of the fabric as it is being filled with fine aggregate concrete. Cable length shall be approximately 10% less than fabric length and the ends of cables which protrude through the fabric shall be provided with clips and external washers so that the cable will be placed in tension when the fabric form is filled with grout. Cables shall each be fastened to separate points of attachment so that the point of anchorage is in a direct line with the cable itself.

If joining of panels as described above is impractical, adjacent panels may be overlapped a minimum of 3 feet (900 mm), subject to Engineer's approval. In no case will simple butt joints between panels be allowed. However, a modified butt joint where an underlayment of similar fabric is sewn to one panel and overlapped a minimum of 2 feet (600mm) by the adjacent panel is allowed subject to Engineer's approval.

### D. Fine Aggregate Concrete Injection

Following placement of AB fabric panels over the geotextile filter cloth, fine aggregate concrete shall be injected between the upper and lower layers of fabric through small slits cut in the upper layer of fabric. The injection pipe shall be wrapped tightly at the point of injection with a strip of burlap during pumping. First pump the upper edge of the mat which has been placed in the anchor trench followed by injection into the lower edge, working back up the slope. Avoid overpressuring of the fabric. After pumping, the burlap shall be pushed into the slit as the injection pipe is withdrawn in order to minimize spillage of fine aggregate concrete on the revetment surface. The burlap seal shall be removed prior to the final set of the fine aggregate concrete and the injection area hand finished. The sequence of fine aggregate concrete injection shall be such as to insure complete filling of the revetment forming fabric to the thickness specified by the fabric manufacturer.

Foot traffic will not be permitted on the freshly pumped mat when such traffic will cause permanent indentations in the mat surface. Walk boards shall be used where necessary.

Excessive fine aggregate concrete which has been inadvertently spilled on the mat surface shall be cleaned up with a broom and shovel. Use of a water hose to remove spilled grout from the surface of a freshly pumped mat will not be permitted.

During grout injection, the mat thickness may be measured by inserting a short piece of stiff wire through the mat at several locations from the crest to the toe of the slope. Any mat measuring less than 90% of the average of all thickness measurements shall be re-injected until desired average thickness has been attained.

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# Appendix C

## Project Schedule

Appendix C  
Project Schedule  
Northwest Cap Slope Enhancement  
San Jacinto River Waste Pits  
Channelview, TX

ID	Task Name	Duration	Week -1	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16
1	<b>Preconstruction Activities</b>	<b>27 days</b>																	
2	Fabricate ACBM Panels	15 days																	
3	Collect Concrete Grout Test Samples from Vendor	1 day																	
4	Complete Strength Testing on Concrete Samples	1 day																	
5	Complete Bridge Repairs (TxDOT)	1 day																	
6	Conduct Project Kickoff Meeting (Web-Ex)	1 day																	
7	<b>Mobilization and Site Preparation</b>	<b>5 days</b>																	
16	<b>Installation of Grouted Fabric Forms</b>	<b>13 days</b>																	
17	<b>Prepare ACBM Panels with Non-Woven Geotextile and Sand Bags</b>	<b>9 days</b>																	
28	<b>Install ACBM Panels</b>	<b>10 days</b>																	
39	<b>Grout ACBM Panels</b>	<b>12 days</b>																	
50	<b>Site Restoration and Demobilization</b>	<b>8 days</b>																	

GHD Project 11191381  
March 25, 2019

Task  Milestone  Summary  Progress   
\*Durations Are Approximate and Subject to Change Due to Weather and Other Unforeseen Delays.



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